

Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

1. (Currently Amended) A one-dimensional piezoelectric actuator array comprising:

a piezoelectric device which comprises substrate having a plurality of comb teeth arranged in a one-dimensional matrix and connected to one another at a first end of the piezoelectric device substrate, at least one of the comb teeth being one of a plate-shaped piezoelectric member or and a pillar-shaped piezoelectric member, and having at least one pair of electrodes formed thereon, the one-dimensional matrix forming a plane extending along a length of the comb teeth from the first end of the piezoelectric device substrate to an opposite end thereof and contacting each of the plurality of comb teeth; and on the piezoelectric member: said piezoelectric device being driven based on a piezoelectric effect of the piezoelectric member and being disposed in a planar form,

— wherein the piezoelectric device constitutes a piezoelectric device substrate, is formed in a planar comb shape as a whole in which comb teeth are connected to one another at one end of the piezoelectric device, and comb teeth portions thus formed are functioned as a plurality of driving portions;

wherein a guide substrate having a concave portion for housing at least a part of the piezoelectric device substrate, is further provided in a predetermined position the concave portion extending parallel to the plane of the one-dimensional matrix, and

wherein the guide substrate and the piezoelectric device substrate are integrally unified in such a manner that a resultant is the guide substrate and the piezoelectric device substrate are readily usable as individual stacks for formation of multiply stacked multiple stack structural body.

2. (Currently Amended) The one-dimensional piezoelectric actuator array according to claim 1,

wherein the guide substrate includes at least one of projections and/or ridges arranged at an interval corresponding to a width between the driving portions ~~piezoelectric members~~ positioned adjacently each other in a bottom surface of the concave portion for housing, and

wherein the respective at least one of projections and/or ridges are inserted between driving portions ~~the piezoelectric members~~ positioned adjacently adjacent to each other, and the guide substrate and the piezoelectric device substrate are integrally unified.

3. (Original) The one-dimensional piezoelectric actuator array according to claim 2, ~~wherein further comprising~~ a wiring circuit is further disposed on the guide substrate and connected to the electrodes.

4. (Currently Amended) A two-dimensional piezoelectric actuator array comprising a plural number~~plurality~~ of one-dimensional piezoelectric actuator arrays multiply stuck, and a plurality of driving portions is structurally aligned and arranged in a plural number~~stacked together~~, wherein said one-dimensional piezoelectric actuator array comprising:

~~a piezoelectric device which comprises substrate having a plurality of comb teeth arranged in a one-dimensional matrix and connected to one another at a first end of the piezoelectric device substrate, at least one of the comb teeth being one of a plate-shaped piezoelectric member and a or pillar-shaped piezoelectric member, and having at least one pair of electrodes formed thereon, the one-dimensional matrix forming a plane extending along a length of the comb teeth from the first end of the piezoelectric device substrate to an opposite end thereof and contacting each of the plurality of comb teeth; and on the piezoelectric member: said piezoelectric device~~

being driven based on a piezoelectric effect of the piezoelectric member and being disposed in a planar form;

— wherein the piezoelectric device constitutes a piezoelectric device substrate, is formed in a planar comb shape as a whole in which comb teeth are connected to one another at one end of the piezoelectric device, and comb teeth portions thus formed are functioned as a plurality of driving portions;

— wherein a guide substrate having a concave portion for housing at least a part of the piezoelectric device substrate, the concave portion extending parallel to the plane of the one-dimensional matrix. is further provided in a predetermined position; and

— wherein the guide substrate and the piezoelectric device substrate are integrally unified in such a manner that a resultant is readily usable for formation of multiply stuck structural body.

5. (Currently Amended) The two-dimensional piezoelectric actuator array according to claim 4, wherein the guide substrate includes at least one of projections and/or ridges arranged at an interval corresponding to a width between the driving portionspiezoelectric members positioned adjacently each other in a bottom surface of the concave portion for housing, and

wherein the respective at least one of projections and/or ridges are inserted between driving portionspiezoelectric members positioned adjacently adjacent to each other, and the guide substrate and the piezoelectric device substrate are integrally unified.

6. (Original) The two-dimensional piezoelectric actuator array according to claim 4, whereinfurther comprising a wiring circuit is further disposed on the guide substrate and connected to the electrodes.

7. (Currently Amended) A two-dimensional piezoelectric actuator array[[[:]]] comprising:

— a structurally aligned plural number plurality of piezoelectric devices device substrates, each of which comprises piezoelectric device substrate having a plurality of comb teeth connected to one another at one end of the piezoelectric device substrate, at least one of the comb teeth being one of a plate-shaped piezoelectric member or and a pillar-shaped piezoelectric member, and having at least one pair of electrodes formed thereon on the piezoelectric member; and said piezoelectric device being driven based on a piezoelectric effect of the piezoelectric member and being disposed in a planar form;

— wherein the piezoelectric device constitutes a piezoelectric device substrate, is formed in a planar comb shape as a whole in which comb teeth are connected to one another at one end of the piezoelectric device, and comb-teeth portions thus formed are functioned as a plurality of driving portions;

wherein a first guide frame member is disposed additionally, said first guide frame being of a hollow box shape and having a plurality of pairs of guide grooves for housing at the plurality of piezoelectric device substrates, the guide grooves being formed on two opposed inner surfaces facing each other of the guide frame member, in accordance with a number of piezoelectric device substrates to be housed in an aligned state in a predetermined position at a predetermined interval, and said the guide grooves being arranged in pairs at an interval corresponding to a thickness of the piezoelectric device substrate, and

wherein the plurality of piezoelectric device substrates is inserted and housed in the corresponding guide grooves of the first guide frame member such that each piezoelectric device substrate is aligned in a corresponding pair of the guide grooves, and the plurality of driving portions are structurally aligned/arranged piezoelectric members remain movable within the guide frame member throughout a portion of the piezoelectric members having the pair of electrodes formed thereon.

8. (Currently Amended) The two-dimensional piezoelectric actuator array according to claim 7 which further comprises comprising a lid member in which having

slits are formed at an interval the same as an interval as between two guide grooves positioned adjacently each other; said the slits having a shape corresponding to a shape of tip ends of the plurality of driving portions piezoelectric members,

wherein the tip ends of the plurality of driving portions piezoelectric members are inserted into the slits to be fixed at predetermined positions, respectively.

9. (Currently Amended) The two-dimensional piezoelectric actuator array according to claim 8 which further comprises comprising wiring components having a structure aligned/arranged in a spatial manner same as that of the plurality of driving portions piezoelectric members and being connected to respective electrodes.

10. (Currently Amended) A one-dimensional piezoelectric actuator array comprising:

— a plurality of piezoelectric devices arranged in a one-dimensional matrix in an independently separated state, each of which comprises a piezoelectric device which comprises one of a plate-shaped piezoelectric member and a or pillar-shaped piezoelectric member, and having at least one pair of electrodes formed thereon, the one-dimensional matrix forming a plane extending along a longitudinal length of the piezoelectric devices and contacting each of the plurality of piezoelectric devices; on the piezoelectric member: said piezoelectric device being driven based on a piezoelectric effect of the piezoelectric member and being disposed in a planar form, — wherein a plurality of piezoelectric devices is arranged in a planar form in an independently separated state,

wherein a guide substrate having a concave portion for housing at least a part of each of the plurality of piezoelectric devices, the concave portion extending parallel to the plane of the one-dimensional matrix at a predetermined position is further disposed in addition to a plurality of piezoelectric devices, and

wherein the guide substrate and the plurality of piezoelectric devices are integrally unified, thereby a resultant is easily multiply stuck to from a multiply stuck in such a manner that the guide substrate and the plurality of piezoelectric devices are readily usable as individual stacks for formation of a multiple stack structural body.

11. (Currently Amended) A two-dimensionally aligned piezoelectric actuator array comprising:

~~a spatially aligned plurality of piezoelectric devices, each of which comprises a piezoelectric device which comprises comprising one of a plate-shaped piezoelectric member or and a pillar-shaped piezoelectric member, and at least one pair of electrodes formed on the piezoelectric member; and said piezoelectric device being driven based on a piezoelectric effect of the piezoelectric member and being disposed in a planar form,~~

~~wherein a second guide frame member, is disposed additionally; said second guide frame member having a plurality of openings arranged in a grid form, and a housing space being channeled through the plurality of openings and fixing a plurality of piezoelectric devices by housing it, and~~

~~wherein the respective piezoelectric devices are fixed within the second guide frame member by inserting each of the plurality of piezoelectric devices to the into corresponding plurality of openings of the housing space of the second guide frame member, thereby the plurality of piezoelectric devices are spatially aligned/arranged remain movable within the second guide frame member throughout a portion of the piezoelectric devices having the pair of electrodes formed thereon.~~

12. (Currently Amended) The two-dimensional piezoelectric actuator array according to claim 11 which further comprises comprising wiring components having a structure aligned/arranged in a spatially manner same as that of the plurality of driving portions piezoelectric devices and being connected to respective electrodes.

13. (Withdrawn) A manufacturing method of a one-dimensional piezoelectric actuator array comprising at least one piezoelectric device which comprises a plate or pillar-shaped piezoelectric member, and at least one pair of electrodes formed on the piezoelectric member: said piezoelectric device being driven based on a piezoelectric effect of the piezoelectric member and being disposed in a planar form, the method comprising the steps of:

forming a piezoelectric material in a sheet shape to prepare a piezoelectric sheet;

forming a pair of electrodes on at least one surface of the piezoelectric sheet;

forming the piezoelectric sheet in a planar comb shape as a whole in which comb teeth are connected to one another at one end of the piezoelectric sheet to prepare a piezoelectric device substrate in which comb-teeth portions function as a plurality of driving portions;

preparing a guide substrate having a concave portion for housing at least a part of the piezoelectric device substrate with unifying integrally them in a predetermined position; and

housing the piezoelectric device substrate in the guide substrate to prepare the one-dimensional piezoelectric actuator array in which the plurality of driving portions constituting the piezoelectric device substrate are aligned/arranged in the planar manner.

14. (Withdrawn) A manufacturing method of a piezoelectric actuator array comprising structurally aligned pluralities of piezoelectric devices each of which piezoelectric device comprises a plate or pillar-shaped piezoelectric member, and least one pair of electrodes formed on the piezoelectric member: said piezoelectric device being driven based on a piezoelectric effect of the piezoelectric member and being disposed in a planar form, the method comprising the steps of:

forming a piezoelectric material in a sheet shape to prepare a piezoelectric sheet;

forming a pair of electrodes on at least one surface of the piezoelectric sheet; forming the piezoelectric sheet as a whole in a planar comb shape in which comb teeth are connected to one another in one end to prepare a plurality of piezoelectric device substrates in which comb-teeth portions constitute a plurality of driving portions;

preparing a guide substrate having a concave portion for housing at least a part of the piezoelectric device substrate to be integrally housed in a predetermined position;

housing the piezoelectric device substrate in the guide substrate to prepare a one-dimensional piezoelectric actuator array; and

stacking multiply a plurality of one-dimensional piezoelectric actuator arrays to prepare the two-dimensional piezoelectric actuator array in which the plurality of driving portions constituting the piezoelectric device substrate are structurally aligned/arranged.

15. (Withdrawn) The manufacturing method of the two-dimensional piezoelectric actuator array according to claim 14, further comprising the steps of:

forming positioning means having a positioning function at time for sticking multiply the plurality of one-dimensional piezoelectric actuator arrays in the guide substrate;

housing the piezoelectric device substrate in the guide substrate to prepare the one-dimensional piezoelectric actuator array, and

forming a two-dimensional piezoelectric actuator array in which the plurality of driving portions constituting the piezoelectric device substrate are structurally aligned/arranged by using the function of the positioning means to stack multiply thus formed plurality of one-dimensional piezoelectric actuator arrays.

16. (Withdrawn) The manufacturing method of the two-dimensional piezoelectric actuator array according to claim 15, wherein the positioning means comprises a through hole and/or a marker.

17. (Withdrawn) A manufacturing method of a piezoelectric actuator array comprising a structurally aligned plural number of piezoelectric devices each of which comprises a plate or pillar-shaped piezoelectric member, and at least one pair of electrodes formed on the piezoelectric member: said piezoelectric device being driven based on a piezoelectric effect of the piezoelectric member and being disposed in a planar form, the method comprising the steps of:

 forming a piezoelectric material into a sheet shape to prepare a plural number of piezoelectric sheets;

 forming a pair of electrodes in at least one surface of each piezoelectric sheet, respectively;

 forming each piezoelectric sheet in a planar comb shape as a whole in which comb teeth are connected to one another in one end of the piezoelectric sheet to prepare each piezoelectric device substrate in which comb-teeth portions constitute a plurality of driving portions;

 preparing a first guide frame being of a hollow box shape and having a plurality of pairs of guide grooves for housing a plurality of piezoelectric device substrates in two inner surfaces facing each other of the guide frame member in accordance with a plural number of piezoelectric device substrates to be housed therein in an aligned state in a predetermined position at a predetermined interval, and said guide grooves being arranged at an interval corresponding to a thickness of the piezoelectric device substrate; and

 housing a predetermined plural number of piezoelectric device substrates in guide grooves of the first guide frame member to prepare a two-dimensional piezoelectric actuator array in which the plurality of driving portions constituting the piezoelectric device substrate is structurally aligned/arranged.